*Astrophysical Masers:
Unlocking the Mysteries of the Universe
Proceedings IAU Symposium No. 336, 2017
A. Tarchi, M.J. Reid & P. Castangia, eds.*

doi:10.1017/S1743921318000819

Rapid burst of 6.7 GHz methanol maser in the high mass star region G33.641-0.228

Kārlis Bērziņš, Ivar Shmeld and Artis Aberfelds

Engineering Research Institute Ventspils International Radio Astronomy Centre (VIRAC), Ventspils University College, Inzenieru 101, LV-3601, Ventspils, Latvia
email: karlis.berzins@venta.lv

Abstract. We report another 6.7 GHz methanol maser burst in the high mass star region G33.641-0.228. The flare is in its second component at $v_{\rm LSR} = 59.6$ km s^{-1} and was observed in August-September 2016 by VIRAC radio telescope RT-32 in Irbene, Latvia. Several bursts of the second spatial component of G33.641-0.228 have been reported previously by Fujisawa *et al.* The maximum peak flux density of the source was measured to reach 343 Jy that is 13 times increase from its ground level. Significant oscillations were discovered during the decay phase indicating a more complex burst mechanism that cannot be explained by a simple heating of the region.

Keywords. ISM: molecules – lines and bands – jets and outflows – magnetic fields

1. Introduction

It is generally thought that 6.7 GHz methanol masers are related to the interstellar medium around high mass stars. Some of them are variable. It is common to observe slow maser variations with typical timescales of months (e.g. Aberfelds *et al.* 2017). The CH_3OH maser source G33.641-0.228 (IRAS 18509+0027) is particularly interesting because it has been observed that only one of its spectral features is bursting, while other components remain constant. The burst of this object was first noticed and described by Fujisawa *et al.* 2012. The methanol maser source was first discovered by Szymczak *et al.* 2000. Its spatial structure has been studied with VLBI (Fujisawa *et al.* 2012, Bartkiewicz *et al.* 2016).

It has been reported that the second methanol maser component of this source has had bursts already several times (Fujisawa *et al.* 2014). Another burst of this component (at $v_{\rm LSR} = 59.6$ km s^{-1}) was observed in August-September of 2016 by the VIRAC 32 m radio telescope. The decay phase was monitored on daily basis during the burst activity.

2. Data and Analysis

After the modernization of the VIRAC radio telescopes in 2016, the G33.641-0.228 was chosen as a good observational candidate for studies of rapid maser variability. Starting from its very first observation in August 25th (Figure 1), an intense source burst (>340 Jy) was detected followed by oscillating decrease. The observations were carried out using the Irbene 32 meter fully steerable radio telescope RT-32 with a cryogenic receiver at 6.7 GHz. The *Rohde & Swartz FSW43* spectrometer was used at the back end to collect the spectral data. Data for only one polarization component were collected. All spectral data were calibrated to absolute intensity flux values within a relative error of 10%. During the decay phase, the burst was observed once per day limited by the source visibility at the RT-32 site. We measured that the intensity flux of the second component

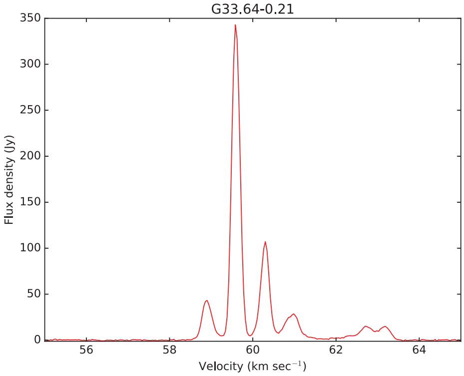

Figure 1. The intensity spectra of G33.641-0.228 on August 25, 2016.

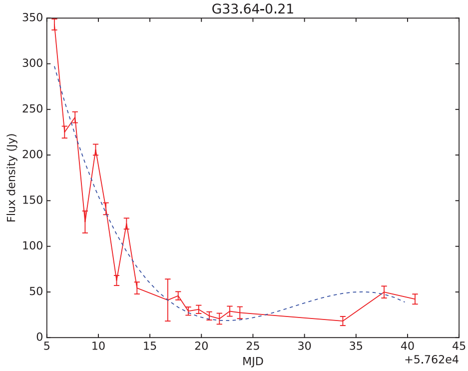

Figure 2. Oscillating afterburst lightcurve (solid line) with 15σ errorbars comparing to smooth decay data fit (dashed line).

of the 6.7 GHz methanol maser in G33.641-0.228 reached the level of at least 343 Jy and decreased afterwards. This is about 13 times above its usual level of 26 Jy.

3. Results and Discussion

The light curve of the burst of the 6.7 GHz maser in G33.641-0.228 (Figure 2) shows a clear oscillating behaviour putting an upper limit to its variability time-scale of the order of hours. Note that other spectral components do not experience such increase of flux intensity meaning that this phenomenon is related to only a limited spatial region. At this stage, we can rule out a simple model of thermal heating of the maser region gaining its thermal energy from a flare-up from the central star because this would be inconsistent with the rapid heating and cooling of a region on time-scales of several hours (less than a day) as detected by our observations. Instead, relatively narrow, well-directed outbursts from the central star causing rapid variations of the magnetic field are thought to be responsible for this kind of oscillating behaviour of the light curve of a single maser component. Regular observations of this source are needed for better understanding its nature and in order to catch further bursts. During the bursts, cooperative observations with better time sampling would be very useful.

Acknowledgements

This work is financed by ERDF project No. 1.1.1.1/16/A/213, being implemented in Ventspils University College.

References

Aberfelds, A., Shmeld, I., & Bērziņš, K. 2017, these Proceedings
&Bartkiewicz, A., Szymczak, M., van Langevelde, H. J. 2016, *A&A* 587, 104
Fujisawa, K., Sugiyama, K., Aoki, N., Hirota, T., Mochizuki, N., Doi, A., Honma, M., Kobayashi, H., Kawaguchi, N., Ogawa, H., Omodaka, T., & Yonekura, Y. 2012, *PASJ* 64, 17
Fujisawa, K., Aoki, N., Nagadomi, Y., Kimura, S., Shimomura, T., Takase, G., Sugiyama, K., Motogi, K., Niinuma, K., Hirota, T., & Yonekura, Y. 2014, *PASJ* 66, 109
Szymczak, M., Hrynek, G., & Kus, A. J. 2000, *A&AS* 143, 269

https://doi.org/10.1017/S1743921318000819 Published online by Cambridge University Press